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COMPRESSOR WELL OPERATIONS IN AZERBAIDZHAN

[Comment: The following report is from I. M. Asadov's book Kompressornyy Sposob Dobychi Nefti i Puti Yego Uluchsheniya (Producing Petroleum by the Compressor Method and Means for Its Improvement), published by Aznefteizdat, Baku, 1955. Tables referred to in the text are appended.]

A total of 140 horizons were uncovered and put into service from 1930 to 1941 in eight principal deposits of the Apsheron Peninsula. Table 1 indicates the flowing and compressor operations in those areas for the above years.

Table 2 indicates the expansion in compressor operations at the oil fields of the Ministry of Petroleum Industry Azerbaydzhan SSR [former Azneft' and Azmorneft' associations, from 1938 to 1954. Over 85 percent of the compressor stations now operating were built and put into service since 1947. The II. Mashtanga and Gyurgyane-More and, to some extent, in the old areas where new sites or horizons were opened. During the period from 1941 to 1954, the increase in the output of compressed air was greater than the increase in the number of compressors because the old compressors were replaced with new units and because certain measures were taken to increase the efficiency of the operating machines.

Table 2 indicates that, beginning in 1947-1948, the output of compressed air changed somewhat but its total volume is still rather significant. This circumstance indicates two things: first, that operations were interrupted to reconstruct the existing compressors and to build new units (the number of compressors was increased somewhat during 1953-1954 by the acquisition of mobile units for particular sites rather than by the construction of stationary stations) and, second, that during the past 6-7 years the Baku fields have had a fleet of powerful and reliable compressors available. Compressor operations still account for a sizable volume of the total output of Azerbaydzhan fields.

Much has been done, during the past several years, to reconstruct deep-well pumping operations in Azerbaydzhan. The old pumping jacks have been replaced with new reductor pumping units; the diameter and piston stroke of the pumps have been enlarged; increased deep-well pumps have been adopted widely; smaller diameter pumps (28-, 32-, and 38-millimeter) have been mastered and are being introduced; the 82-millimeter pipe pump has been mastered; heat-treated alloy rods have become widely accepted, and grade 36GAS alloy pipe is used widely.

An analysis of the compressor wells now operating indicates that only 25 percent maximum can be converted to deep-well pumping without any particular difficulties but with prior readjusting work. The others cannot be converted without great loss in output, with the present pumping equipment, technology of deep-well pumping, considerable depths, curvatures, frequent core formations, and the enormous withdrawal of liquid.

In 1955, the Ministry of Petroleum Industry Azerbaydzhan SSR is obliged to restore 1,500 wells, twice the number in previous years. Another 1,500 wells will have to be restored in 1956. Considering the characteristics of the shut-down stock of wells, the accomplishment of these tasks will require the mastering and rather extended exploitation of some of these wells by the compressor method. There can be no expectation that the number of compressor wells will be drastically reduced in the next few years.

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Forced withdrawal of liquid is complicated in many wells by the inadequate capacity of pumping equipment and the lack of wear-resistant electric charging pumps. Hence, forced withdrawal of liquid can be accomplished in these wells only by means of compressors.

All the principal horizons in Azerbaydzhan are to be pressured during 1956-1958, with 98 horizons comprising the first group to be treated. This task, if it is to be accomplished, will require the volume of water to be pumped daily into the strata to be increased from 60,000 cubic meters at the end of 1954 to 150,000 cubic meters, and the volume of air to be increased from 420,000 to 700,000 cubic meters daily.

Any increased effects from several processes carried out at present depends upon compulsory forced withdrawal of liquid from wells being pressured. For instance, the pressure at the PK strata of the Kala deposit (Azizbekovneft' Oil Field Administration) and the PK strata of Chakhnaglyar site (Kirovneft' Oil Field Administration) should be increased by 15-20 atmospheres, but the increase in pressure does not provide any noticeable effect even in compressor wells at the reached maximum withdrawal of liquid.

The change from dual to single lift in the above field administrations and repeated lowering of the electric pump into wells at the Chakhnaglyar site failed to provide any favorable results because of the large amount of sand present. The only recourse in these cases is to work such wells by dual and higher pressures.

Compressor operations were expanded widely in Azerbaydzhan primarily because of the rapid rise in production during the prewar 5-year plans, putting into service deep and high-yielding horizons containing a large amount of gas and sand in the liquid, and the shortage, until the past few years, of heavy duty deep-well pumping equipment.

Table 3 indicates the rate of development of oil production in Azerbaydzhan by the compressor method from 1937 to 1953. During this period, the number of compressor units was increased to 1.7 times, the output of compressed air was increased to approximately 2.6 times, and the number of wells worked by the compressor method was increased to approximately 1.4 times.

The volume of liquid withdrawn by compressor operations rose to 1.4 times, whereas the percentage of water coming up to the surface with the oil increased from 41 percent in 1938 to 75 percent in 1953. In 1953, compressor operations in Azerbaydzhan accounted for the following (in percent):

Specific weight of total output	36.5
Compressor wells in total number	13.7

In 1953, production costs by the compressor method were comprised of the following items (in percent):

Well amortization	26.0
Amortization of other equipment and installations	11.0
Compressed air	37.0
Underground repairs	9.0
De-emulsification of crude	3.5
Secondary methods	3.5
Pumping and storage	2.0
Other production costs	3.0
General field expenses	5.0
	100.0

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While approximately 25 percent of the existing compressor wells can be converted to deep-well pumps without any particular technological difficulties, the changeover is delayed because of various deficiencies in organization or engineering arrangements. For instance, over 150 compressor wells could be converted readily to deep-well pumping in the Kirovneft' and Stalinneft' oil field administrations, but officials of both administrations blame the delay of conversion on sand core formation. Initiator of breaking up sand formation by pouring liquid into the space between the pipe and well side wall, the Kirovneft' administration is using this method in only ten wells whereas up to 200 wells in the Ordzhonikidzeneft' and Stalinneft' oil field administrations are being worked by pouring in liquid to break up sand core formation.

The Molotovneft' Oil Field Administration, which introduced treatment of the well slope area with a sand-cement mixture, has treated 43 wells by this method.

The conversion from compressor operations to deep-well pumping is being held up at the Bukhta Il'ich Oil Field of the Stalinneft' Oil Field Administration and at the offshore sectors of the Artemneft' Oil Field Administration because of the lack of naval transport.

There are many deep compressor, incline-directional wells in several fields of the Ordzhonikidzeneft', Buzovnyneft', Artemneft', Stalinneft' and Azizbekovneft' field administrations and in fields of the former Kaganovichneft' Trust that give off sand and gas along with liquid. [Comment: Kaganovichneft' Trust was merged in late 1954 with the Ordzhonikidzeneft' Oil Field Administration]. The conversion of these wells to deep pumping is being held up by the lack of proper underground and surface equipment or because of technological shortcomings which lead to losses in petroleum output if changes are made in the method of exploitation.

During 1948-1953, a total of 45 deep compressor wells were converted in the former Kaganovichneft' Trust to deep-well pumps. Their combined daily yield before conversion was 233.2 tons of crude oil and 686 tons of liquid. After they were converted, this combined yield dropped to 129.5 tons of crude oil and 388 tons of liquid daily. The decline in oil yield was 44 percent and that of liquid 43 percent. The period between repairs was shortened from 115 days before conversion to 22 days after conversion. Of the 45 wells converted, 16 shut down by 1954 because of small yields, three were reconverted to compressor operations, and only 26 continued to be worked by pumps in 1954 with a total yield of only 61 tons of crude oil and 148 tons of liquid.

The conversion to deep-well pumping of deep compressor wells containing gas and sand in the liquid results in a reduction in daily yield and in a reduced coefficient of well use, the latter due to increased and prolonged underground repairs.

Despite the high cost of compressed air, the cost per ton of crude oil from a compressor well is less than that from a deep pumping well because of reduced output and increased expenses for underground repairs on pumping wells.

[Appended tables follow:]

Table 1. Flowing and Compressor Operations in Azerbaydzhan, 1930-1941

Year	Crude Output (%)			Sp Wt Wells Operating; Total Start of Year		
	Flow	Compressor	Both	Flow	Compressor	Both
1930	100	100	100	Exact data not available		
1931	159.9	154.1	156.5	"	"	"
1932	80.4	135.8	142.4	"	"	"
1933	200.3	167.3	192.6	"	"	"
1934	203.7	271.7	243.7	"	"	"
1935	177.3	277.4	236.2	"	"	"
1936	130.6	235.3	242.2	"	"	"
1937	233.7	256.1	246.9	"	"	"
1938	204.3	270.9	243.5	"	"	"
1939	137.8	264.7	233.1	3.1	16.5	19.5
1940	207.2	265.0	241.2	2.7	16.1	18.8
1941	224.4	272.4	252.7	2.6	15.9	18.4
				2.7	16.1	18.7

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Table 2. Compressor Operations in Azerbaydzhan, 1938-1954

<u>Year</u>	<u>Compressor Stations (%)</u>	<u>Number Compressors (%)</u>	<u>Average Daily Output Compressed Working Agent (%)</u>
1938	100	100	100
1939	106	104	114
1940	110	112	128
1941	116	120	146
1942	120	126	140
1943	110	103	110
1944	114	119	145
1945	114	117	140
1946	123	128	170
1947	129	146	210
1948	129	154	234
1949	138	160	255.2
1950	129	157	250
1951	153	169	229
1952	155	181.5	235
1953	155	180.1	230
1954	140	174	240

Table 3. Compressor Operations in Azerbaydzhan, 1937-1953

Year	Operating Wells Start of Year (%)	Compressors Installed (%)	Output Compressed Agent (%)	Air Consumption To Lift Liquid (%)	Liquid With- drawn (%)	Water (%)	Specific Consump- tion Air
1937	--	--	100	--	100	43.4	100
1938	100	100	120	--	102	41.2	111
1939	107	104	137	--	105	44.3	130
1940	111	112	154	--	112	47.2	147
1941	118	121	179	--	116	48.0	146
1942	110	128	161	100	94	53.7	158
1943	108	122	145	87	101	59.7	125
1944	97	137	176	106	113	63.8	133
1945	103	139.5	197	116	115	65.9	141
1946	100.1	137	205	127	124	67.4	142
1947	108	151	233	143	138	66.0	143
1948	126	157	263	161	150	69.8	149
1949	141	160	279	162	159	71.0	155
1950	145	165	288	172	153	74.0	154
1951	137	169	288	168	152	75.0	163
1952	139	171	277	148	152	75.4	175
1953	137	168	278	160	141		

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